Estimation of the biomethane methane potential of sewage sludge’s with AMPTS® II

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1. Introduction

The global population growth increases the demand for water resources. Consequently, many research programs on tomorrow’s wastewater treatment plants are conducted on each process step in order to answer water and energy challenges (Ruffino et al. 2015¹). For that purpose, the MOCOPEE (MOdeling, Control and Optimization of wastewater treatment ProcEssEs) project focuses on applied metrology, modeling and on remote monitoring of the whole wastewater treatment process (www.mocopee.com, see next pages for more details); that includes sludge as a by-product of different processes used in the treatment sewage. The different WWTP of the SIAAP (interdepartmental association for sewage disposal of Paris conurbation) produce about 230,000 tons of total solid of different kinds of sludge per year. About 80 % of sludge are methanized and produce about 530 GWh of electricity per year. In the MOCOPEE project, we achieved the BMP tests of these sludges to determine the best ratio to optimize and to increase the robustness of the methanization process. The BMP assay is an important tool and the most commonly used for the assessment of the anaerobic biodegradability of sewage sludge produced during wastewater treatment (Aquino et al., 2008², Mottet et al., 2010³). The objective of this short communication is to succinctly present the BMP determinations of sludge with an AMPTS® II.

2. Materials and methods

The inoculum was systematically collected from the same secondary digester on a WWTP next to Paris, sludges were collected from the WWTPs and at different locations in the process: primary settler (primary sludge), biological tank or biofilter (biological sludge), tertiary settler with chemicals (tertiary sludge). Combinations of primary and biological sludges were sampled (mixed sludge). Physical and chemical properties of the samples and inoculum, Total Solid (TS), Volatile Solid (VS) have been determined according to standardized methods (APHA, 2005)⁴.

Fresh sludges and fresh inoculum have been added in glass bottles of 500 mL each, following the [I]/[S] ratio of 3 based on VS content. This ratio is widely quoted in the literature and advised by the manufacturer. Real-time measurements of the biogas production were achieved during 20-40

¹ Ruffino B. et al., 2015. Improvement of anaerobic digestion of sewage sludge in a wastewater treatment plant by means of mechanical and thermal pre-treatments: Performance, energy and economical assessment. Bioresource technology, 175, 298-308
² Aquino S. et al., 2008. Methodologies for determining the bioavailability and biodegradability of sludges. Environmental technology, 29(8), 855-862
days at 35 ± 0.2 °C. The endogenous methane produced, corresponding to the anaerobic sludge used as inoculum, was subtracted for the other samples.

3. Results

The Figure below presents the methane production for the nineteen samples that show that AMPTS® is a reliable and convenient device to determine the BMP values of WWTP’s sludges.
Partnership between scientists and wastewater treatment operators

1 A BIT OF BACKGROUND

Rules concerning wastewater treatment and quality of water discharged into the environment have changed considerably. In 1991, the implementation of the European Directive on the collection, treatment and discharge of wastewater, had requested the member states of the European Union to identify areas sensitive to eutrophication, in which discharges of phosphorus and nitrogen should be reduced. By then, the Water Framework Directive (WFD, 2000/60/CE) imposed on the member states of the European Union to restore the good ecological (physical, chemical and biological) and chemical (priority substances) status of surface water bodies within 15 years. These regulatory requirements have imposed an upgrade of the Parisian urban wastewater plants in order to provide treatment that can effectively remove pollutants from wastewater. So, significant efforts have been made in the main French cities since early 90’s to integrate water treatment units for chemical treatment of phosphorus and biological treatment of nitrogen (chemical settler tanks, biofiltres, membrane bioreactor, etc.).

If such intensive technologies help maintain a high quality of treatment, their management requires, however, a high level of technical and scientific expertise. In particular, issues related to metrology, monitoring and control of wastewater treatment processes are now positioned at the heart of industrial problems.

In this context, the Interdepartmental Association for Sewage Disposal in Paris Conurbation (SIAAP), the National Scientific and Technological Research Institute on Environment and Agriculture (IRSTEA) and the Technological University of Compiègne (UTC) have joined efforts to build a research program that is in step with the main current challenges. This program is named Mocopee (MOdeling, Control and Optimization of wastewater treatment ProcEssEs).

2 A PROGRAM AT THE INTERFACE BETWEEN INDUSTRY AND RESEARCH

The program is intended as a workspace and perennial exchange platform between scientists and operatives working in the field of urban water treatment. It brings together research teams, operational water stakeholders and industrial partners.

3 GOALS AND BOUNDARIES OF THE MOCOPÉE PROGRAM

The program is built around four pillars dedicated to metrology applied to water treatment, modeling the purification processes, the regulation of the treatment processes and finally industrial innovations.
The Mocopee research program aims to build the metrological (continuous measurement method and matrices characterization) and mathematical tools (signal processing, treatment processes modeling, regulation) required to increase the control and the optimization of water and sludge treatment plants. The program also aims to support industrial innovation by focusing on innovative concepts (new treatment methods or new operating practices).

4 INVOLVED PARTIES IN THE RESEARCH PROGRAM

Academic scientific organisations:
Université de Technologie de Compiègne - Transformations intégrées de la matière renouvelable (UTC-TIMR)
Université Paris-Est Créteil – École des Ponts Paris-Tech - Laboratoire Eau, Environnement et Systèmes Urbains (LEESU)
Université Laval - Département de génie civil et de génie des eaux (UL-Canada)
Université Pierre et Marie Curie - Milieux environnementaux, transferts et interactions dans les hydrosystèmes et les sols (UPMC-METIS)
Ecole Supérieure d'Ingénieurs en Electrotechnique et Electronique (ESIEE-Amiens)
Ecole Polytechnique de Louvain – Institute of Information and Communication Technologies, Electronics and Applied Mathematics (EPL-Belgique)
Institut National des Sciences Appliquées. Département génie des procédés et environnement. Laboratoire d’ingénierie systèmes biologiques et procédés (INSA-Toulouse)

National research center:
Institut national de Recherche en Sciences et Technologies pour l’Environnement et l’Agriculture. UR hydrosystèmes et bioprocédés (Antony), UR milieux aquatiques (Lyon) et UR technologie et systèmes d’information pour les agrosystèmes (Montoldre)
Syndicat Interdépartemental pour l’Assainissement de l’Agglomération Parisienne - Direction du développement et de la prospective (Colombes)

Industrial partners:
Envolure®, WatchFrog®

5 A BALANCED APPROACH

The research program is divided into four-year phases (Phase I - 2014-2017). For each phase, a scientific program dealing with both scientific issues and emerging industrial needs is constructed by the combined effort of scientific and technical teams. This mode of four-year periods program is balanced since, on one hand, it involves long-term implication of actions allowing to progress significantly on scientific issues. On the other hand, it keeps up a flexibility and adaptability because of the regular periodic review of scientific guidelines.

6 FOR MORE INFORMATION …

www.mocopee.com
Contact : contact@mocopee.com
Steering and coordination Committee
Vincent Rocher – SIAAP – Direction du Développement et de la Prospective
Jean-Marc Choubert – Irstea – Unité de recherche milieux aquatiques
André Pauss – UTC – Unité Transformations Intégrées de la Matière Renouvelable